LIST OF TABLES

1. INTRODUCTION

Under the final U.S. Environmental Protection Agency (EPA) Sulfur Dioxide (SO_2) Data Requirements Rule (DRR) promulgated on August 21, 2015, state air agencies will seek SO_2 predictive modeling or actual monitoring information for categories of sources based on annual SO_2 emission rates. The focus of the final DRR is on areas with sources whose actual annual SO_2 emissions exceed 2,000 tons per year (tpy). EPA's rationale for using predictive dispersion modeling is the dearth of representative ambient SO_2 monitors and EPA's view that SO_2 is a "source-oriented" criteria pollutant that is relatively stable in the first few kilometers from the source. Thus, this rule directs agencies to focus on specific sources as the main contributors to SO_2 air quality impacts and the way to ascertain those potential source contributions will be through dispersion modeling.

On January 8, 2016, the Arkansas Department of Environmental Quality (ADEQ) submitted a letter to EPA Region 6 regarding SO_2 sources identified pursuant to 40 CFR 51.1202 as required by the DRR for the 1-hour SO_2 National Ambient Air Quality Standard (NAAQS). ADEQ identified FutureFuel Chemical Company (FutureFuel) as a source with actual annual SO_2 emissions of 2,000 tons or more for the 2014 reporting year (i.e., 3,174.31 tpy).

FutureFuel contracted with Trinity Consultants to prepare an SO_2 modeling protocol and complete an SO_2 modeling analysis according to the DRR. Per FutureFuel's discussion with the ADEQ, the FutureFuel modeling analysis will include the actual SO_2 emissions from the nearby Entergy Independence Steam Electric Station (Entergy). According to the March 2, 2015, agreement (Consent Decree) between U.S. EPA and environmental groups, ADEQ was required to designate the area around Entergy plant "early" (no later than July 2, 2016) since Entergy's Independence Station met the Consent Decree criteria. In support of this early designation, Entergy completed a modeling analysis of solely the Independence Station and submitted the results to ADEQ in the *SO_2 Air Dispersion Modeling Report for Independence Steam Electric Station, ERM Project No. 0268066*, dated August 2015 (the August 2015 report). On September 11, 2015, Governor Hutchinson recommended to EPA that Independence County be designated as "Unclassifiable/Attainment". This recommendation was based on the Entergy modeling analysis. Per ADEQ's request, FutureFuel will complete a combined SO_2 modeling analysis, considering both FutureFuel and Entergy emissions in their analysis.

The 1-hour SO_2 characterization modeling will adhere to the following guidance documents: the February 2016 "SO_2 NAAQS Designations Modeling Technical Assistance Document" (TAD) issued in draft form by the EPA, the final DRR for the 2010 1-hour SO_2 primary NAAQS, and any direction received from the ADEQ Air Division Planning Branch. The 1-hour SO_2 characterization modeling will be conducted using AERMOD (version 15181) using default model options (unless otherwise noted in this document), meteorological data from 2012-2014 as described in Section 3.5, and the actual 2012-2014 emissions rates discussed in Section 3.3. Modeled concentrations will be predicted over the extensive receptor grid described in Section 3.6, and will include an ambient background concentration as described in Section 3.4.

The modeled concentrations predicted by AERMOD (including background) will be calculated based on the form of the 1-hour SO_2 NAAQS. The total design concentration will be compared to the 1-hour SO_2 primary NAAQS to determine if the area surrounding FutureFuel and Entergy should be designated as attainment or non-attainment.

The results of the analysis will be documented in a report submitted to ADEQ, which will also include a complete electronic modeling archive on CD.

This section presents a description of the FutureFuel facility location and site characteristics required as part of the air dispersion modeling evaluation.

2.1. FACILITY LOCATION

FutureFuel is located approximately 12 kilometers (km) southeast of Batesville in Independence County, Arkansas. Figure 2-1 provides a map of the area surrounding FutureFuel's property. The approximate central Universal Transverse Mercator (UTM) coordinates of the facility are 633,080 meters (m) east and 3,953,700 m north in Zone 15 [North American Datum 1983 (NAD 83)]. As shown in Figure 2-1, the facility is located in a very rural area of the White River valley, comprised of mixed forest and agricultural land with flat, rolling and hilly terrain all nearby.

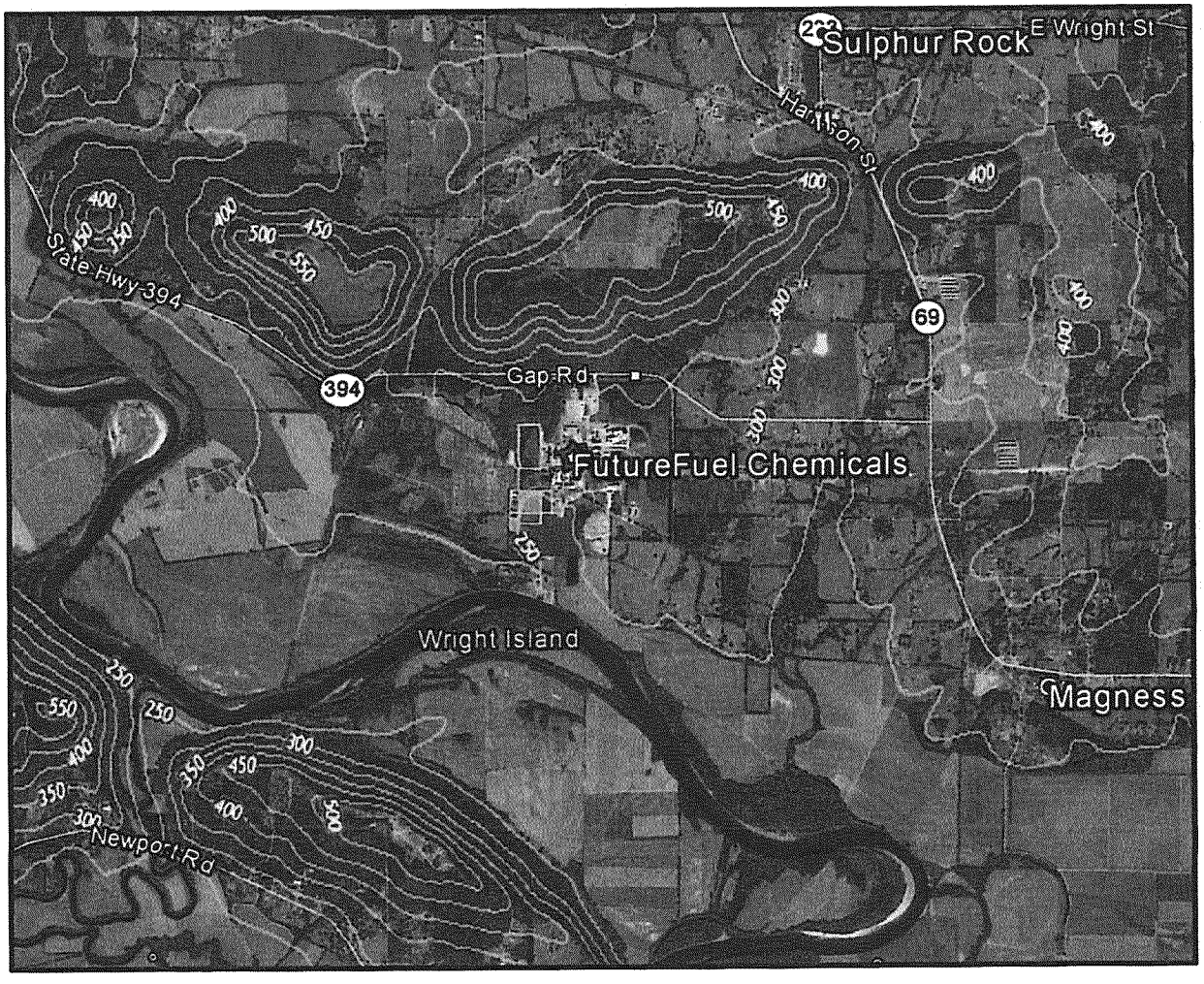

Figure 2-1. Aerial Map of Area Surrounding FutureFuel Facility

Figure 2-2 shows the relative locations of FutureFuel and Entergy. Entergy is located approximately 11.4 kilometers southeast of FutureFuel and is in an area of generally flat terrain.

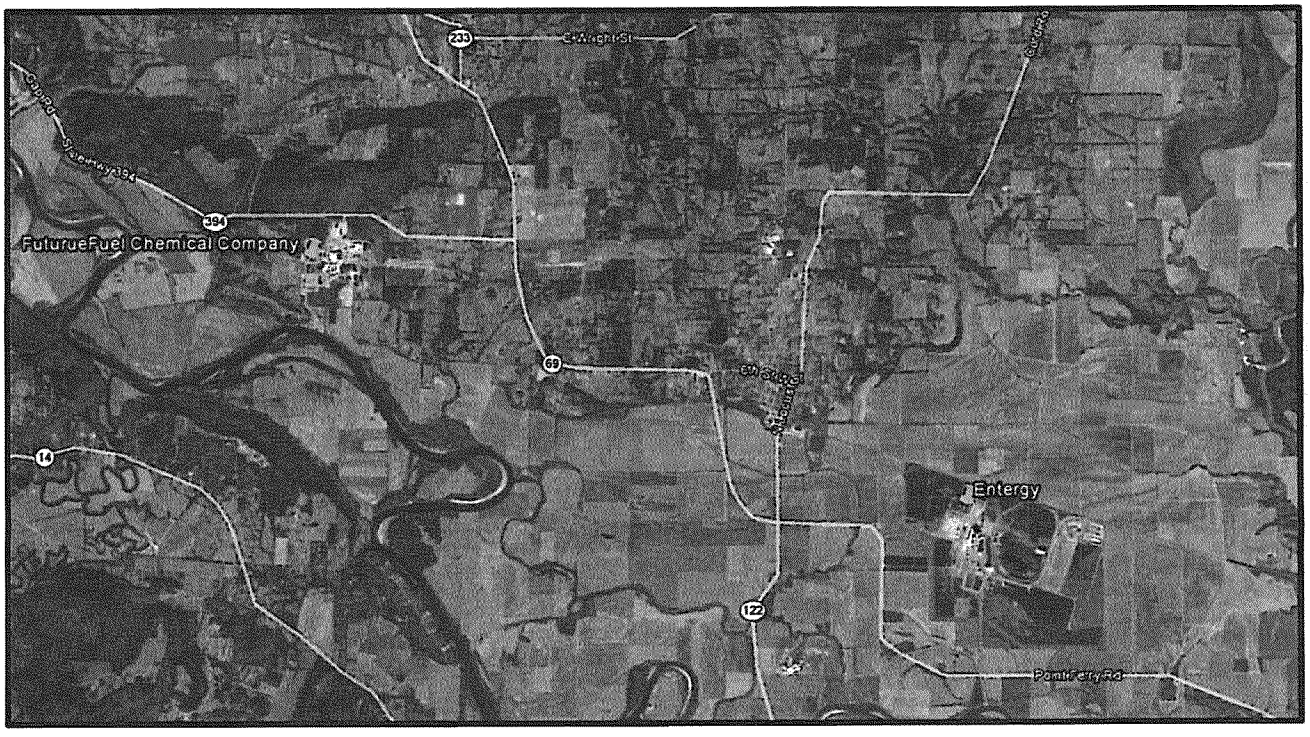

Figure 2-2 Relative Locations of FutureFuel and Entergy

Figure 2-3 shows an aerial map of FutureFuel with the SO_2 sources labeled. Figure 2-4 presents a plot plan of FutureFuel showing the major buildings and SO_2 sources. Refer to Entergy's August 2015 report for more details about their site and SO_2 emissions.

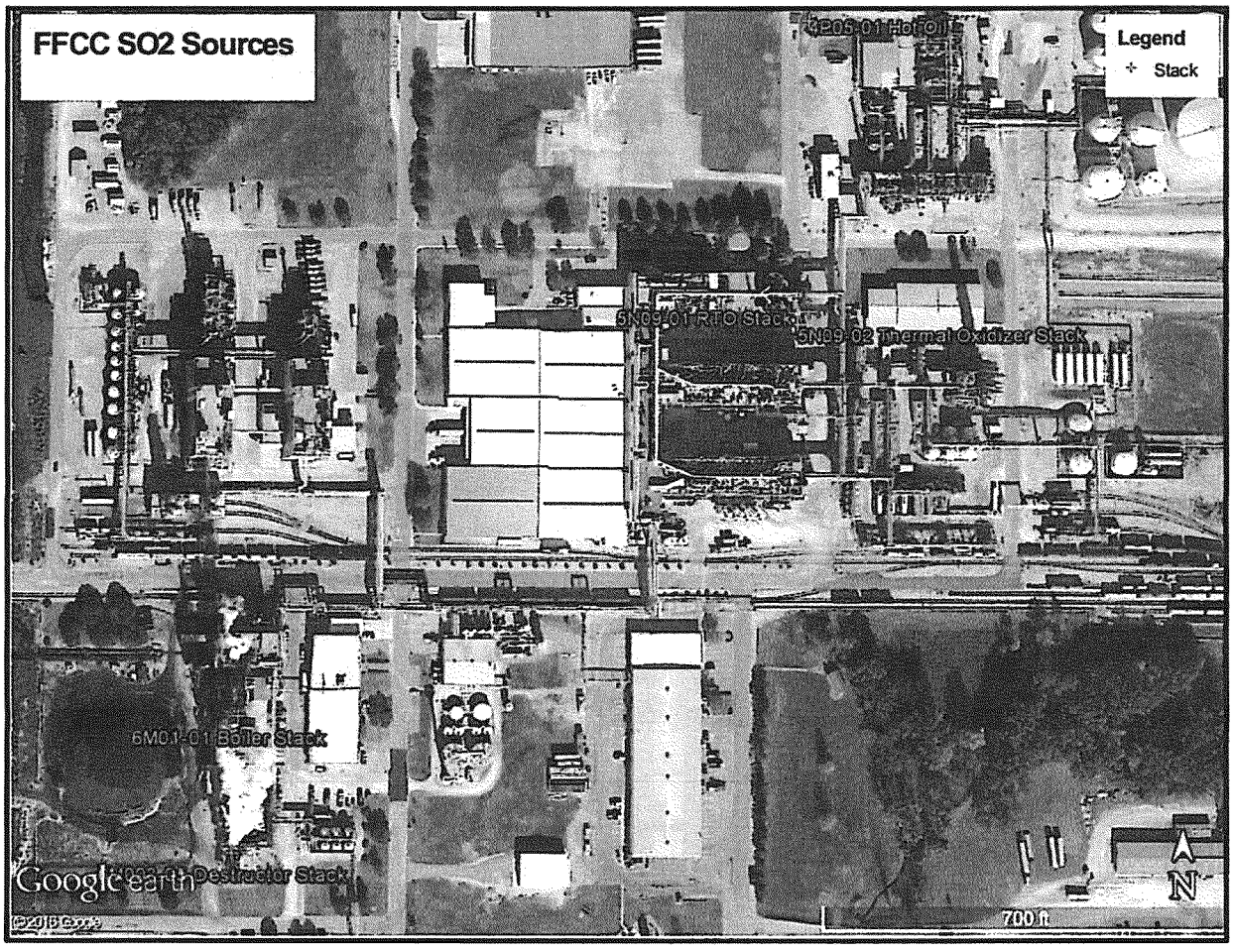

Figure 2-3. Aerial Map of FutureFuel Facility

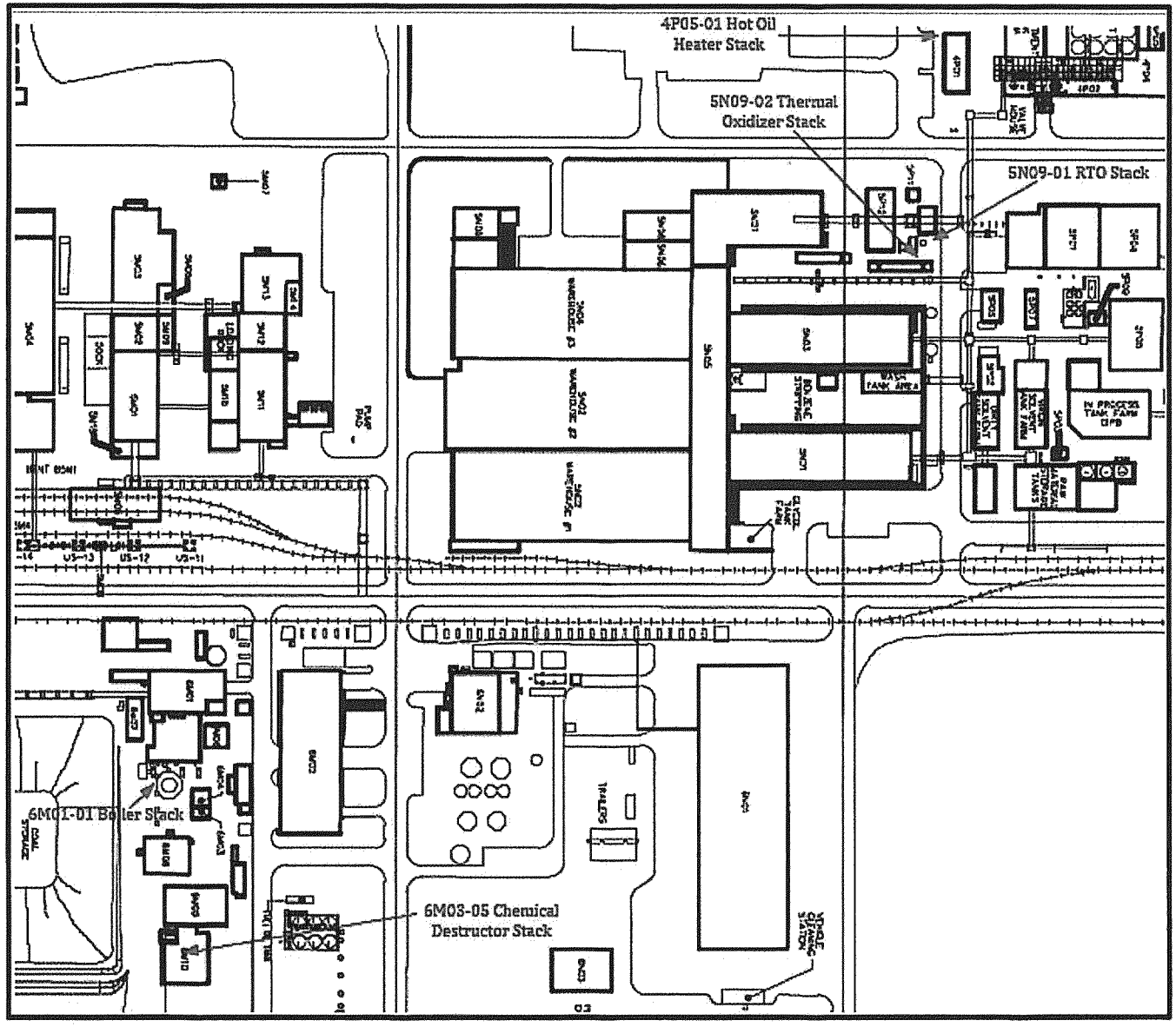

Figure 2-4. FutureFuel Plot Plan

3. DISPERSION MODELING ANALYSIS

This section presents the input data and modeling methodology that will be utilized in the SO_2 NAAQS modeling demonstration. The modeling methodology generally conforms to the Modeling TAD.[1]

3.1. MODEL SELECTION

Modeling will be performed for the 1-hour SO_2 analysis following the Modeling TAD. The AERMOD Model Version 15181[2], the most current version released by EPA on July 24, 2015 on the Support Center for Regulatory Air Modeling (SCRAM) website[3], will be used to perform the dispersion modeling. The proposed update to EPA's modeling guidance in the form of the *Guideline on Air Quality Models*[4], was released on July 15, 2015 via the EPA technical website.[5]

3.2. SOURCE DESCRIPTION

All SO_2 emitting sources at FutureFuel will be modeled except for five very small SO_2 sources (less than 3.8 lb/hr total) and per EPA's clarification memorandum, intermittent emergency sources such as an emergency diesel-fired generator and fire water pump engines.[6] The modeled sources account for 98.5% of allowable SO_2 emissions from the facility. Additionally, SO_2 emitting sources from the nearby Entergy plant will be modeled. Table 3-1 presents a table of the sources that will be modeled and their locations. All locations are expressed in UTM Zone 15 coordinates.

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[1] https://www3.epa.gov/airquality/sulfurdioxide/pdfs/SO2ModelingTAD.pdf

[2] Stated by U.S. EPA to be part of the docket at Docket ID No. EPA-HQ-OAR-2015-0310 and available as of date of submittal of this report.

[3] http://www.epa.gov/ttn/scram/dispersion_prefrec.htm#aermod

[4] *Guideline on Air Quality Models.* Appendix W to 40 CFR Parts 51 and 52. Federal Register, November 9, 2005. pp. 68217-68261.

[5] https://www3.epa.gov/ttn/scram/11thmodconf/9930-11-OAR_AppendixW_Proposal.pdf

[6] https://www3.epa.gov/ttn/scram/guidance/clarification/Additional_Clarifications_AppendixW_Hourly-NO2-NAAQS_FINAL_03-01-2011.pdf

Table 3-1. Modeled Source Locations

Model ID	Description	UTM-E (m)	UTM-N (m)	Elevation (m)
FF_5N091	RTO	633,660.39	3,953,915.79	81.94
FF_6M01	Coal Fired Boilers	633,343.50	3,953,692.29	83.57
FF_6M03	Chemical Waste Destructor	633,336.15	3,953,628.65	81.50
FF_4P05	Hot Oil System	633,692.56	3,954,022.81	83.40
FF_5N092	Thermal Oxidizer/Caustic Scrubber	633,629.84	3,953,907.38	83.86
EN_SN01	Entergy Unit 1 Boiler	644,086.7	3,949,432.5	71.52
EN_SN02	Entergy Unit 2 Boiler	644,089.8	3,949,441.4	71.53
EN_SN05	Entergy Auxiliary Boiler	644,064.1	3,949,338.7	71.46
EN_SN20	Entergy Emergency Diesel Generator	643,993.0	3,949,472.0	71.58
EN_SN21	Entergy Emergency Diesel Fire Pump	644,011.0	3,949,296.0	71.43

All modeled sources are point sources and Table 3-2 presents the stack parameters that will be input to the model for each of the sources. Sources EN_SN20 and EN_SN21 discharge horizontally and as such will be modeled with a minimal exit velocity (0.001 m/s).

Table 3-2. Modeled Source Parameters

Model ID	Stack Height (m)	Stack Temperature (K)	Exit Velocity (m/s)	Stack Diameter (m)
FF_5N091	18.29	390.31	9.63	2.44
FF_6M01	60.96	485.26	14.42	2.74
FF_6M03	26.57	357.93	12.18	1.22
FF_4P05	5.20	477.60	2.70	0.46
FF_5N092	7.62	345.15	9.27	0.24
EN_SN01	304.8	433.71	27.43	7.83
EN_SN02	304.8	433.71	27.43	7.83
EN_SN05	4.57	519.26	19.81	0.91
EN_SN20	4.27	790.54	0.001	0.25
EN_SN21	4.27	644.26	0.001	0.13

3.3. MODELED EMISSION RATES

As described in the Modeling TAD, attainment modeling demonstrations are intended to represent actual facility emissions. Four of the five FutureFuel units will use actual monthly average emissions data for the 2012-2014 period. For the lowest emitting unit (Thermal Oxidizer, Model ID 5N09_02), the maximum hourly allowable permit limit (3.0 lb/hr SO_2) was modeled as a worst-case. Three of the Entergy units (Model ID EN_SN01, EN_SN02, and EN_SN05) will use actual hourly emissions data for the 2012-2014 model. The emergency fire pump (Model ID EN_SN20) and emergency generator (Model ID EN_SN21) at Entergy will use variable emission rates based on actual engine testing times as described in Entergy's August 2015 report. The EMISFACT option in AERMOD will be utilized to supply the varying monthly emission rates for the units with monthly emission rate data and to supply Entergy's emergency units with the variable emission rates for weekly testing times. Table 3-3 shows the annual average hourly emission rate for the FutureFuel sources for comparative purposes.

Table 3-3. Average Hourly Modeled SO_2 Emission Rates

Model ID	2012 Average Emission Rate (lb/hr)	2013 Average Emission Rate (lb/hr)	2014 Average Emission Rate (lb/hr)
FF_5N091	0.09	0.09	0.05
FF_6M01	561.53	604.68	697.43
FF_6M03	2.53	4.41	3.49
FF_4P05	0.00005	0.00006	0.00006
FF_5N092	3.00	3.00	3.00

Note: The Entergy emission rates are described in their August 2015 report.

3.4. BACKGROUND CONCENTRATIONS

NAAQS modeling demonstrations typically include impacts from the applicant's facility and a background concentration from a representative ambient monitor. When including background concentrations, the potential for double-counting exists, where impacts from explicitly modeled sources may also be included in the concentration measured by the ambient monitor. In their "Clarification Memorandum for 1-hour NO_2 Modeling" *(herein referred to as 1-hour NO_2 Guidance)*, EPA provides a general "rule-of-thumb" for estimating the area over which regional inventory sources should be included. That section of the guidance goes on to suggest that for most applications, the inclusion of nearby sources within about 10 km would be sufficient. This guidance is based on the concept of "significant concentration gradient" in which modeled impacts from a given facility are reviewed to determine how quickly concentrations diminish out from the site. Although Entergy is over 11 km from FutureFuel, the SO_2 emissions from Entergy will be included in the model.

Ambient background data from the closest SO_2 monitor, located in Little Rock (Monitor ID# 05-119-0007), will be used to represent other sources of SO_2 in the background. The only other SO_2 monitor in Arkansas is located in El Dorado in the southern portion of the state. EPA Guidance allows the inclusion of background values that vary by season and hour of day that could simulate a lower value than the 99th percentile design value from the monitor. The modeling will be performed with a set of seasonal diurnal values developed using methodology described in the *1-hour NO_2 Guidance* which addresses NO_2 modeling and the process for developing seasonal diurnal background values for SO_2. Table 3-4 shows the seasonal diurnal values that will be used in the model.

Table 3-4. Seasonal Diurnal SO_2 Concentrations at Little Rock Monitor

Hour	Winter ($\mu g/m^3$)	Spring ($\mu g/m^3$)	Summer ($\mu g/m^3$)	Fall ($\mu g/m^3$)
1	6.89	5.67	4.80	5.50
2	7.85	5.32	4.28	6.19
3	7.33	6.19	4.45	6.02
4	6.89	5.76	4.19	4.71
5	8.55	4.97	4.19	5.15
6	9.60	4.80	5.41	5.85
7	9.60	6.28	5.50	6.63
8	8.99	5.24	6.11	6.54
9	7.50	6.46	7.68	7.85
10	8.38	8.20	7.42	9.07
11	9.16	8.46	9.95	8.20
12	10.73	15.09	10.38	9.34
13	9.69	11.08	10.91	11.17
14	10.56	9.34	9.86	9.51
15	10.03	8.20	13.18	9.95
16	9.42	7.94	9.34	10.47
17	7.15	9.86	11.08	9.16
18	7.50	7.42	9.69	7.24
19	9.25	6.37	9.86	6.98
20	12.30	6.54	8.73	5.93
21	9.07	6.02	6.19	6.28
22	6.11	8.99	5.76	5.67
23	6.46	7.07	5.67	5.85
24	7.24	6.81	5.41	6.11

Figure 3-1 shows the relative locations of the FutureFuel facility, Entergy, the meteorological site and the SO_2 monitor.

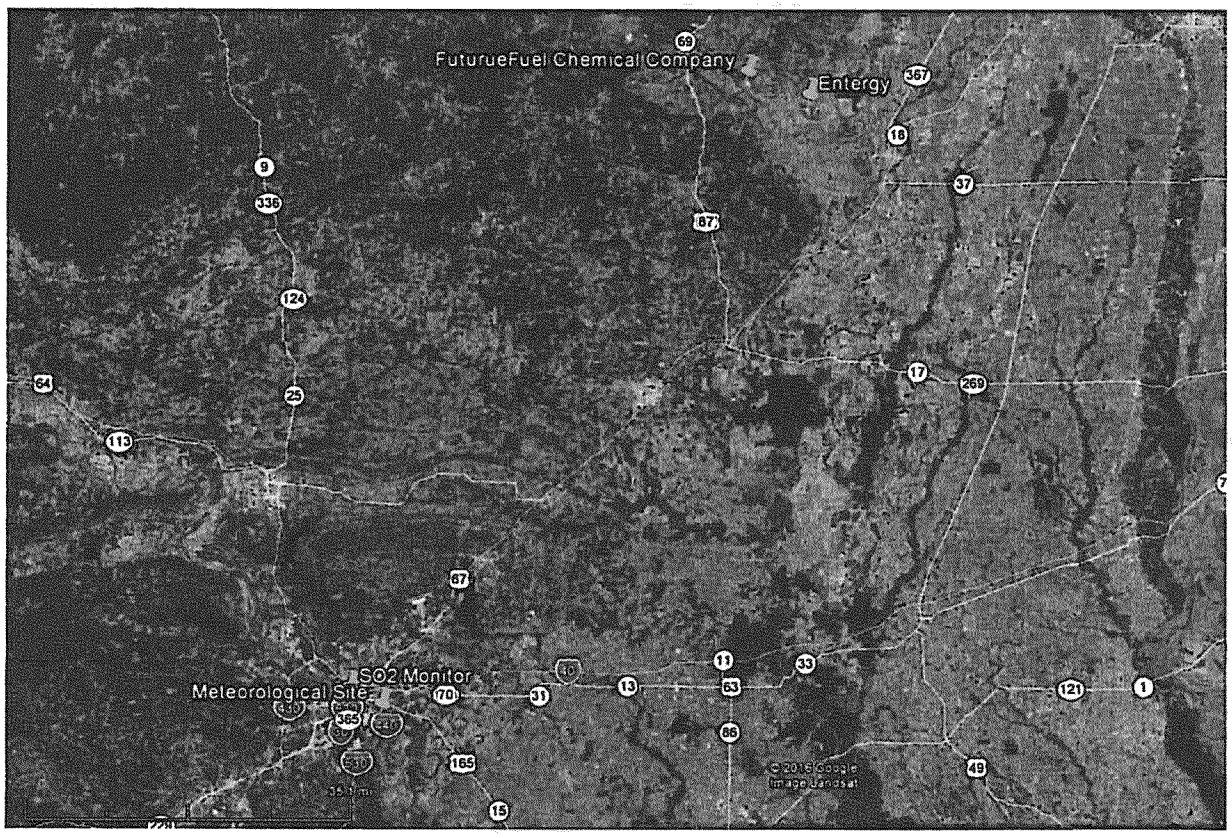

Figure 3-1. Relative Locations of FutureFuel Facility, Entergy, Meteorological Site, and SO_2 Monitor

3.5. METEOROLOGICAL DATA

AERMOD-ready meteorological data for the period 2012-2014 was prepared using the latest version of the EPA's AERMET meteorological processing utility (version 15181) and will be used for this analysis. Standard EPA meteorological data processing guidance was used as outlined in a recent memorandum[7] and other documentation.

3.5.1. Surface Data

Raw hourly surface meteorological data was obtained from the U.S. National Climatic Data Center (NCDC) for Little Rock Clinton National Airport/Adams Field (KLIT, WMO ID: 722310) in the standard ISHD format. This data was supplemented with TD-6405 (commonly referred to as "1-minute ASOS") wind data from KLIT. The 1-

[7] Fox, Tyler, U.S. Environmental Protection Agency. 2013. "Use of ASOS Meteorological Data in AERMOD Dispersion Modeling." Available Online: http://www.epa.gov/ttn/scram/guidance/clarification/20130308_Met_Data_Clarification.pdf

minute wind data was processed using the latest version of the EPA AERMINUTE pre-processing tool (version 15272). Quality of the 1-minute data was verified by comparison to the hourly ISHD data from KLIT, which showed only small differences typical of 1-minute and hourly wind data comparisons. The "Ice-Free Winds Group (IFWG)" option was utilized in AERMINUTE due to the fact that a sonic anemometer was installed at KLIT on May 21, 2009. [8] As such, the IFWG option was engaged for the full 2012-2014 period. Figure 3-2 shows the distribution of wind speed and direction for the site.

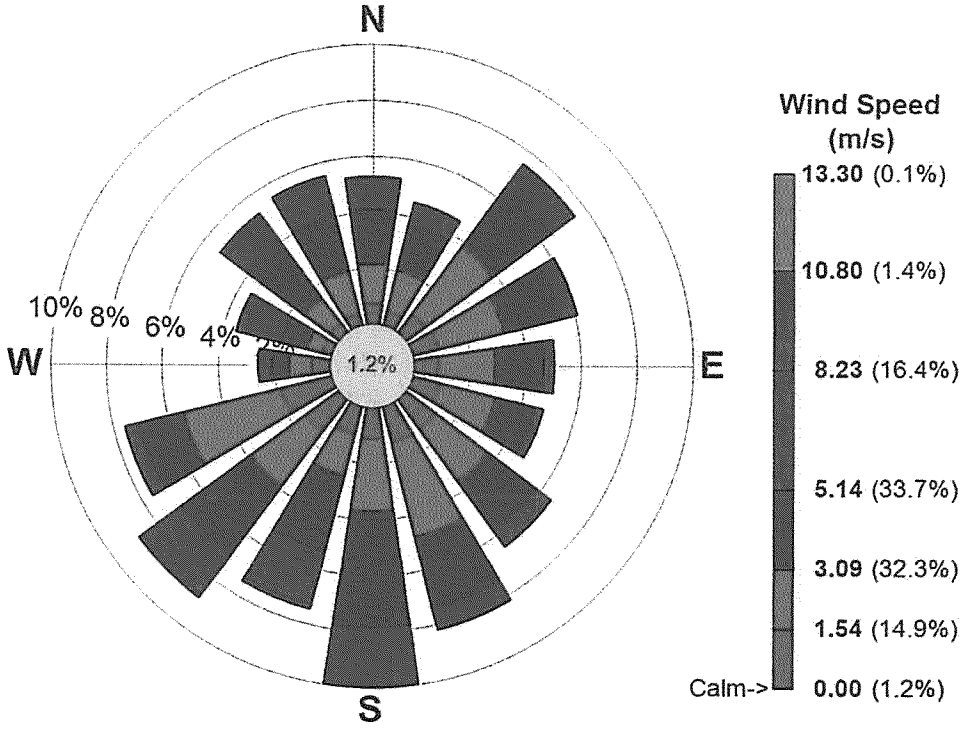

Figure 3-2. 2012-2014 Wind Rose for Little Rock Airport (KLIT)

3.5.2. Upper Air Data

In addition to surface meteorological data, AERMET requires the use of data from a sunrise-time upper air sounding to estimate daytime mixing heights. The nearest U.S. National Weather Service (NWS) upper-air radiosonde station is located in Little Rock, AR (LZK). Upper air data for the same 2012-2014 time period were obtained from the National Oceanic and Atmospheric Administration (NOAA) in FSL format.[9]

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[8] http://www.nws.noaa.gov/ops2/Surface/documents/IFW_stat.pdf

[9] http://esrl.noaa.gov/raobs/

3.5.3. Land Use Analysis

Parameters derived from the analysis of land use data (surface roughness, Bowen ratio, and albedo) are also required by AERMET. In accordance with EPA guidance, these values will be determined using the latest version of the EPA AERSURFACE tool (version 13016).[10] The AERSUFACE settings that will be used for processing are summarized in Table 3-5. The met station coordinates were determined by visually identifying the met station in Google Earth. NLCD 1992 (CONUS) Land Cover data that will be used in AERSURFACE processing was obtained from the Multi-Resolution Land Use Consortium (MRLC).

EPA recommendations were used to specify the area used for the AERSURFACE analysis. Surface roughness was estimated based on land use within a 1 km radius of the meteorological station, with directional variation in roughness accounted for by dividing that circle into sectors with common landuse types. By default, AERSURFACE assumes twelve 30-degree landuse sectors. In cases where the landuse is uniform, that is an acceptable approach. However, in the case of the LIT airport, there are four (4) directional sectors with truly distinct landuse categories. Figure 3-3 shows the wind direction sectors input to AERSURFACE for the surface roughness portion of the landuse analysis.

[10] U.S. Environmental Protection Agency. 2013. "AERSURFACE User's Guide." EPA-454/B-08-001, Revised 01/16/2013. Available Online: http://www.epa.gov/scram001/7thconf/aermod/aersurface_userguide.pdf

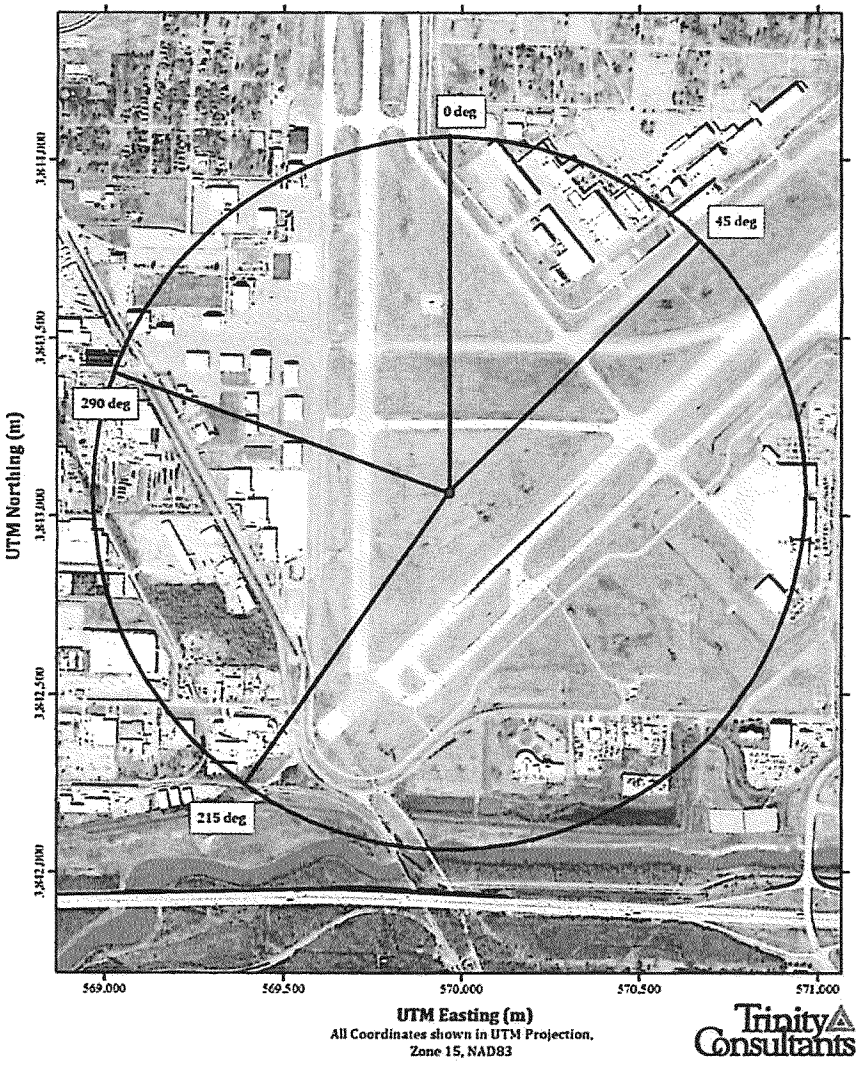

Figure 3-3. AERSURFACE Land Use Sector Analysis

Albedo and Bowen ratio are regional parameters and were estimated within AERSURFACE, based on the default 10x10 km box centered on the meteorological station.

EPA guidance dictates that on at least an annual basis, precipitation at a surface site should be classified as wet, dry, or average in comparison to the 30-year climatological record at the site. This determination is used to adjust the Bowen ratio estimated by AERSURFACE. To make the determination, annual precipitation in each

modeled year (2012-2014) was compared to the 1981-2010 climatological record for KLIT.[11] The 30th and 70th percentile values of the annual precipitation distribution from 1981-2010 were calculated. Per EPA guidance, each modeled year was classified for AERSUFACE processing as "wet" if its annual precipitation was higher than the 70th percentile value, "dry" if its annual precipitation was lower than the 30th percentile value, and "average" if it was between the 30th and 70th percentile values. The values that will be used in this case are included in Table 3-5.

The site location does not experience meteorological seasons like the default seasonal categories in AERSURFACE, therefore the monthly categories were modified to better represent the meteorological seasons the site experiences. The modified seasons are shown in Table 3-6.

Table 3-5. AERSURFACE Input Parameters

AERSURFACE Parameter	Value
Met Station Latitude	34.727266
Met Station Longitude	-92.235811
Datum	NAD 1983
Radius for surface roughness (km)	1.0
Vary by Sector?	Yes
Number of Sectors	4 (0-45, 45-215, 215-290, 290-360)
Temporal Resolution	Seasonal
Continuous Winter Snow Cover?	No
Station Located at Airport?	Yes
Arid Region?	No
Surface Moisture Classification	Dry (2012), Wet (2013), Average (2014)

Table 3-6 Modified AERSURFACE Seasons

Seasonal Category	Season Description	Month Assignments
1	Midsummer with lush vegetation	May, Jun, Jul, Aug, Sept
2	Autumn with unharvested cropland	Oct, Nov
3	Late autumn after frost and harvest, or winter with no snow	Dec, Jan, Feb
5	Transitional spring with partial green coverage or short annuals	Mar, Apr

[11] National Climatic Data Center. 2010 Local Climatological Data (LCD), (KMSY).